

Model Name: P650HVN02.5

Issue Date: 2013/03/28

(*)Preliminary Specifications

()Final Specifications

Customer Signature	Date	AUO	Date
Approved By _____		Reviewed By PM Director Paley Fang _____	
Note		Reviewed By RD Director Eugene CC Chen _____	
		Reviewed By Project Leader Dalon Tseng _____	
		Prepared By PM Antonio Kuo _____	

Contents

Record of Revision	3
1. General Description	4
2. Absolute Maximum Ratings	5
3. Electrical Specification	6
3.1.1 Electrical Characteristics	6
3.1.2 AC Characteristics	6
3.3 Signal Timing Specification	13
3.4 Signal Timing Waveforms	14
3.5 Color Input Data Reference	15
3.6 Power Sequence	16
3.7 Backlight Specification.....	17
3.7.1 Electrical specification	17
3.7.2 Input Pin Assignment	18
4. Optical Specification.....	20
5. Mechanical Characteristics	23
5.1 Placement suggestions:.....	23
Front View.....	24
Back View	25
6. Reliability Test Items.....	26
7. International Standard	27
8. Packing	28
8-1 DEFINITION OF LABEL:	28
8-2 PACKING METHODS:	29
8-3 Pallet and Shipment Information	30
9. PRECAUTIONS	31
9-1 MOUNTING PRECAUTIONS	31
9-2 OPERATING PRECAUTIONS.....	31
9-3 ELECTROSTATIC DISCHARGE CONTROL	32
9-4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE	32
9-5 STORAGE	32
9-6 HANDLING PRECAUTIONS FOR PROTECTION FILM.....	32
9-7 OPERATING CONDITION in PID APPLICATION.....	32

Record of Revision

[illegible]

1. General Description

This specification applies to the 64.5 inch Color TFT-LCD Module P650HVN02.5. This LCD module has a TFT active matrix type liquid crystal panel 1920 x 1080 pixels, and diagonal size of 64.5 inch. This module supports 1920 x 1080 mode. Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 10-bit gray scale signal for each dot.

The P650HVN02.5 has been designed to apply the 10-bit 2 channel LVDS interface method. It is intended to support displays where high brightness, wide viewing angle, high color saturation, and high color depth are very important.

* General Information

Items	Specification	Unit	Note
Active Screen Size	64.53	inch	
Display Area	1428.48 (H) x 803.52 (V)	mm	
Outline Dimension	1508.0(H) x 878.0(V) x 12.8(D)	mm	
Driver Element	a-Si TFT active matrix		
Display Colors	10 bit, 1.07B	Colors	
Number of Pixels	1920 x 1080	Pixel	
Pixel Pitch	0.744	mm	
Pixel Arrangement	RGB vertical stripe		
Display Operation Mode	Normally Black		
Surface Treatment	Anti-Glare, 3H		Haze 11%
Display Orientation	Portrait/Landscape Enable		[1]

Note:

[1] Please refer to **5.1 Placement Suggestions**.

2. Absolute Maximum Ratings

The followings are maximum values which, if exceeded, may cause faulty operation or damage to the unit

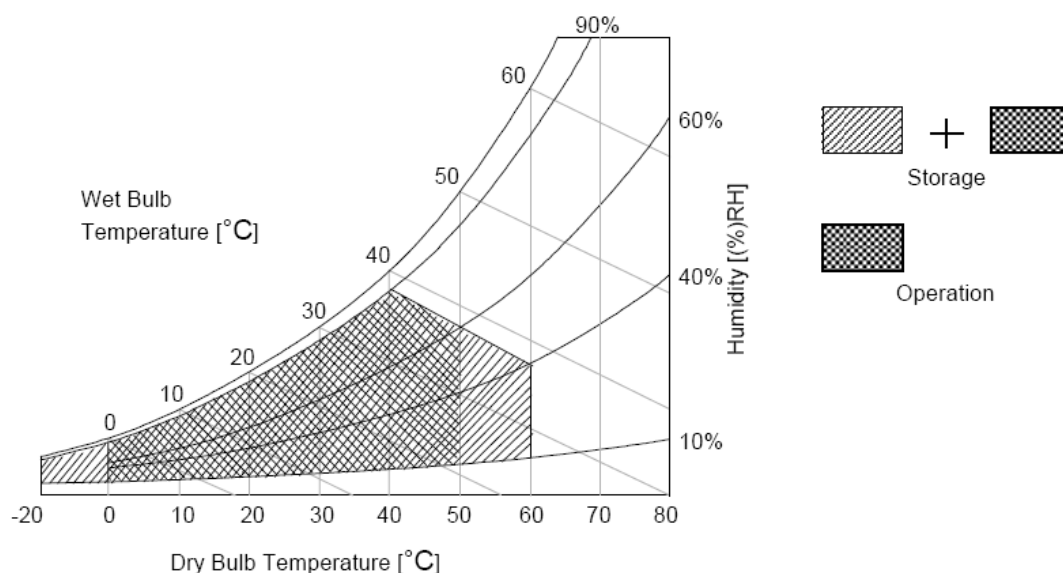
Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	Vcc	-0.3	14	[Volt]	Note 1
Input Voltage of Signal	Vin	-0.3	4	[Volt]	Note 1
Operating Temperature	TOP	0	+50	[°C]	Note 2
Operating Humidity	HOP	10	90	[%RH]	Note 2
Storage Temperature	TST	-20	+60	[°C]	Note 2
Storage Humidity	HST	10	90	[%RH]	Note 2
Panel Surface Temperature	PST		65	[°C]	Note 3

Note 1: Duration:50 msec.

Note 2 : Maximum Wet-Bulb should be 39°C and No condensation.

The relative humidity must not exceed 90% non-condensing at temperatures of 40°C or less. At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C.

Note 3: Surface temperature is measured at 50°C Dry condition



3. Electrical Specification

The P650HVN02.5 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second is employed for LED driver.

3.1.1 Electrical Characteristics

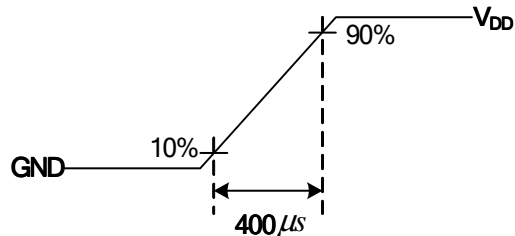
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max		
LCD							
Power Supply Input Voltage		V_{DD}	10.8	12	13.2	V_{DC}	
Power Supply Input Current		I_{DD}	--	0.58	1.1	A	1
Power Consumption		P_C	--	6.96	13.2	Watt	1
Inrush Current		I_{RUSH}	-	--	7.5	A	2
Permissible Ripple of Power Supply Input Voltage (for input power=12V)		V_{RP}	--	--	$V_{DD} * 5\%$	mV _{pk-pk}	3
LVDS Interface	Input Differential Voltage	$ V_{ID} $	200	400	600	mV _{DC}	4
	Differential Input High Threshold Voltage	V_{TH}	+100	--	+300	mV _{DC}	4
	Differential Input Low Threshold Voltage	V_{TL}	-300	--	-100	mV _{DC}	4
	Input Common Mode Voltage	V_{ICM}	1.1	1.25	1.4	V_{DC}	4
CMOS Interface	Input High Threshold Voltage	V_{IH} (High)	2.7	--	3.3	V_{DC}	5
	Input Low Threshold Voltage	V_{IL} (Low)	0	--	0.6	V_{DC}	
Backlight Power Consumption		P_{BL}	--	206.4	216.1	W	
Life Time(MTTF)			50,000	--	--	--	6, 7

3.1.2 AC Characteristics

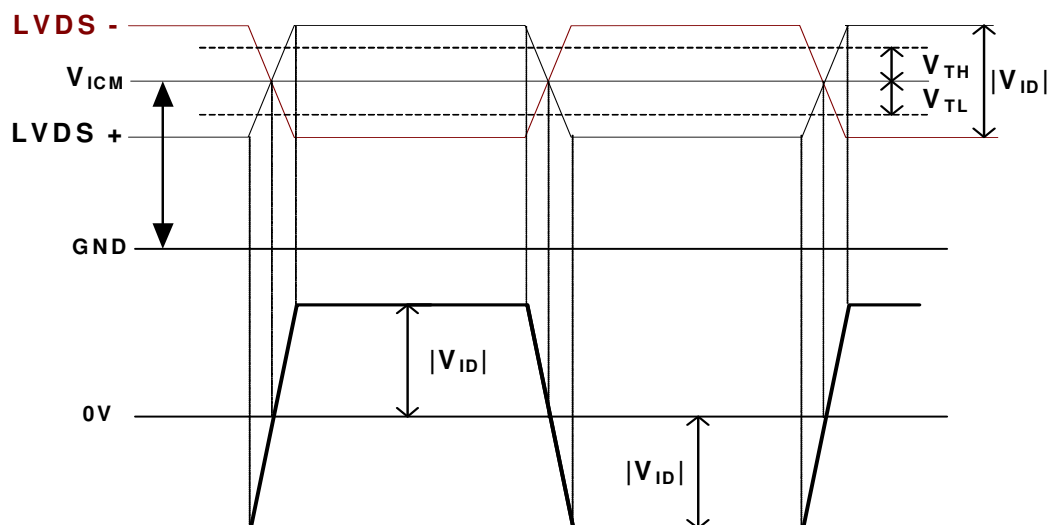
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max		
LVDS Interface	Input Channel Pair Skew Margin	$t_{SKEW (CP)}$	-500	--	+500	ps	8
	Receiver Clock : Spread Spectrum Modulation range	Fclk_ss	Fclk -3%	--	Fclk +3%	MHz	9
	Receiver Clock : Spread Spectrum Modulation frequency	Fss	30	--	200	KHz	9
	Receiver Data Input Margin Fclk = 85 MHz Fclk = 65 MHz	tRMG	-0.4 -0.5	-- --	0.4 0.5	ns	10

Note :

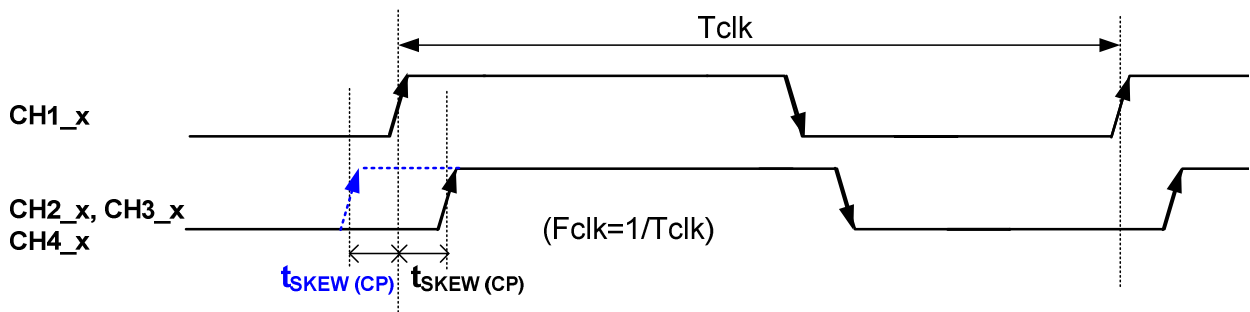
1. $T_{VDD} = 12.0V$, $F_v = 60Hz$, $F_{clk} = \text{Max freq.}$, $25^\circ C$, Test Pattern : White Pattern
>> refer to "Section:3.3 Signal Timing Specification, Typical timing"
2. Measurement condition : Rising time = 400us



3. Test Condition:
 - (1) The measure point of V_{RP} is in LCM side after connecting the System Board and LCM.
 - (2) Under Max. Input current spec. condition.
4. $V_{ICM} = 1.25V$

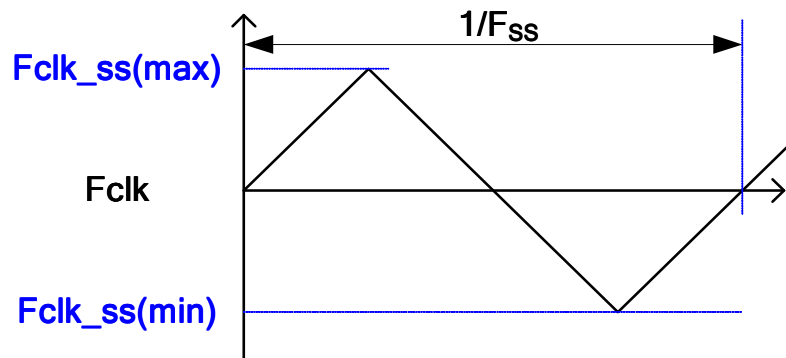


5. The measure points of V_{IH} and V_{IL} are in LCM side after connecting the System Board and LCM.
6. The relative humidity must not exceed 80% non-condensing at temperatures of $40^\circ C$ or less. At temperatures greater than $40^\circ C$, the wet bulb temperature must not exceed $39^\circ C$. When operating at low temperatures, the brightness of LED will drop and the life time of LED will be reduced.
7. The lifetime (MTTF) is defined as the time which luminance of LED is 50% compared to its original value.
[Operating condition: Continuous operating at $T_a = 25 \pm 2^\circ C$]
8. Input Channel Pair Skew Margin



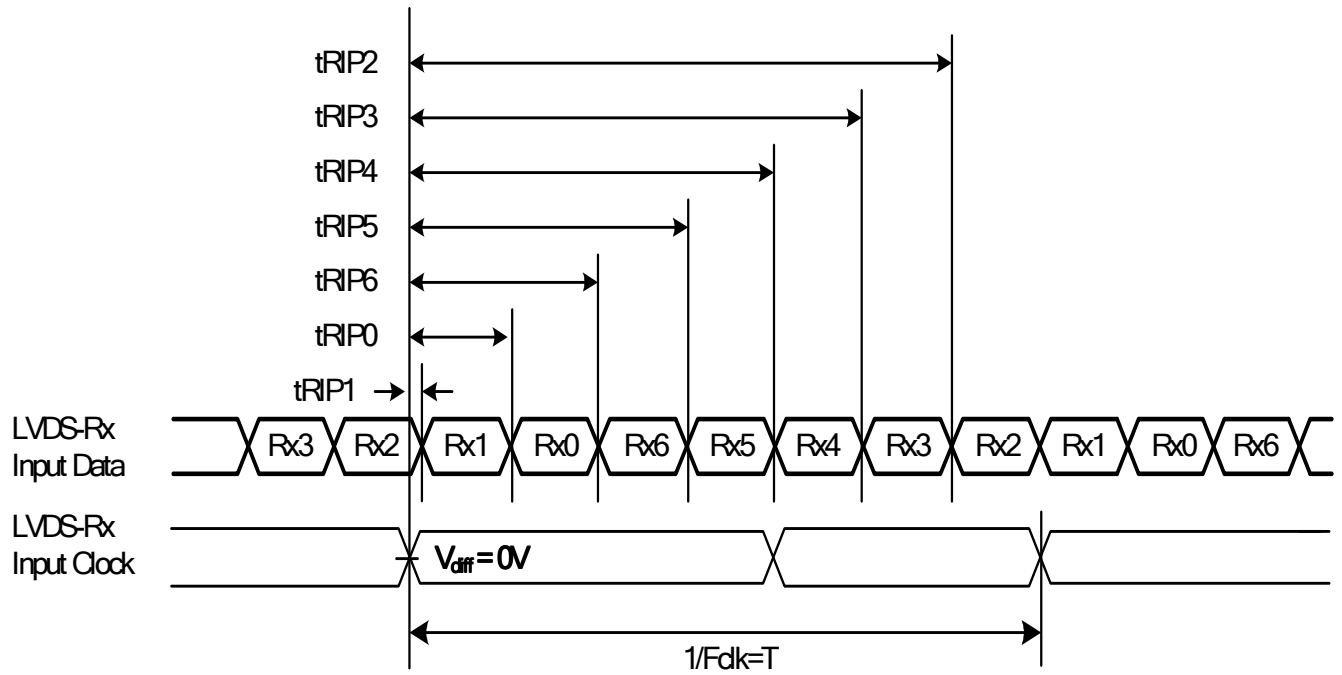
Note: x = 0, 1, 2, 3, 4

9. LVDS Receiver Clock SSCG (Spread spectrum clock generator) is defined as below figures



10. Receiver Data Input Margin

Parameter	Symbol	Rating			Unit	Note
		Min	Type	Max		
Input Clock Frequency	Fclk	Fclk (min)	--	Fclk (max)	MHz	$T=1/F_{clk}$
Input Data Position0	tRIP1	$- t_{RMG} $	0	$ t_{RMG} $	ns	
Input Data Position1	tRIP0	$T/7- t_{RMG} $	$T/7$	$T/7+ t_{RMG} $	ns	
Input Data Position2	tRIP6	$2T/7- t_{RMG} $	$2T/7$	$2T/7+ t_{RMG} $	ns	
Input Data Position3	tRIP5	$3T/7- t_{RMG} $	$3T/7$	$3T/7+ t_{RMG} $	ns	
Input Data Position4	tRIP4	$4T/7- t_{RMG} $	$4T/7$	$4T/7+ t_{RMG} $	ns	
Input Data Position5	tRIP3	$5T/7- t_{RMG} $	$5T/7$	$5T/7+ t_{RMG} $	ns	
Input Data Position6	tRIP2	$6T/7- t_{RMG} $	$6T/7$	$6T/7+ t_{RMG} $	ns	



3.2 Interface Connections

- LCD connector : FI-RE51S-HF (Manufactured by JAE);
- Mating connector: FI-RE51S-HL (Manufactured by JAE)

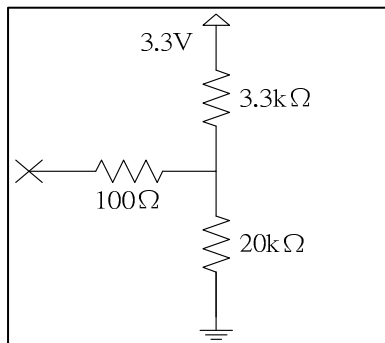
PIN	Symbol	Description	PIN	Symbol	Description
1	Reserve	AUO Internal Use Only	26	GND	Ground
2	Reserve	AUO Internal Use Only	27	GND	Ground
3	Reserve	AUO Internal Use Only	28	CH2_0-	LVDS Channel 2, Signal 0-
4	Reserve	AUO Internal Use Only	29	CH2_0+	LVDS Channel 2, Signal 0+
5	BITSEL	Open/High(3.3V) for 10bit, Low(GND) for 8bit	30	CH2_1-	LVDS Channel 2, Signal 1-
6	Reserve	AUO Internal Use Only	31	CH2_1+	LVDS Channel 2, Signal 1+
7	LVDS_SEL	Open/High(3.3V) for NS, Low(GND) for JEIDA	32	CH2_2-	LVDS Channel 2, Signal 2-
8	Reserve	AUO Internal Use Only	33	CH2_2+	LVDS Channel 2, Signal 2+
9	Reserve	AUO Internal Use Only	34	GND	Ground
10	Reserve	AUO Internal Use Only	35	CH2_CLK-	LVDS Channel 2, Clock -
11	GND	Ground	36	CH2_CLK+	LVDS Channel 2, Clock +
12	CH1_0-	LVDS Channel 1, Signal 0-	37	GND	Ground
13	CH1_0+	LVDS Channel 1, Signal 0+	38	CH2_3-	LVDS Channel 2, Signal 3-
14	CH1_1-	LVDS Channel 1, Signal 1-	39	CH2_3+	LVDS Channel 2, Signal 3+
15	CH1_1+	LVDS Channel 1, Signal 1+	40	CH2_4-	LVDS Channel 2, Signal 4-
16	CH1_2-	LVDS Channel 1, Signal 2-	41	CH2_4+	LVDS Channel 2, Signal 4+
17	CH1_2+	LVDS Channel 1, Signal 2+	42	GND	Ground
18	GND	Ground	43	GND	Ground
19	CH1_CLK-	LVDS Channel 1, Clock -	44	GND	Ground
20	CH1_CLK+	LVDS Channel 1, Clock +	45	GND	Ground
21	GND	Ground	46	GND	Ground
22	CH1_3-	LVDS Channel 1, Signal 3-	47	Reserve	AUO Internal Use Only
23	CH1_3+	LVDS Channel 1, Signal 3+	48	V _{DD}	Power Supply, +12V DC Regulated
24	CH1_4-	LVDS Channel 1, Signal 4-	49	V _{DD}	Power Supply, +12V DC Regulated
25	CH1_4+	LVDS Channel 1, Signal 4+	50	V _{DD}	Power Supply, +12V DC Regulated
			51	V _{DD}	Power Supply, +12V DC Regulated

Note 1: All GND (ground) pins should be connected together and should also be connected to the LCD's metal frame.

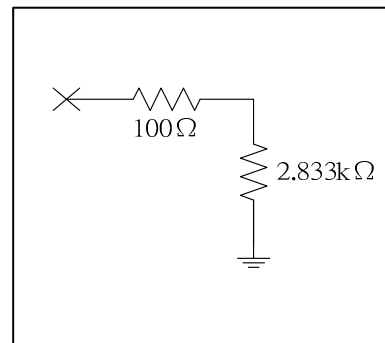
Note 2: All V_{DD} (power input) pins should be connected together.

Note 3: All Reserved pins should be open without voltage input.

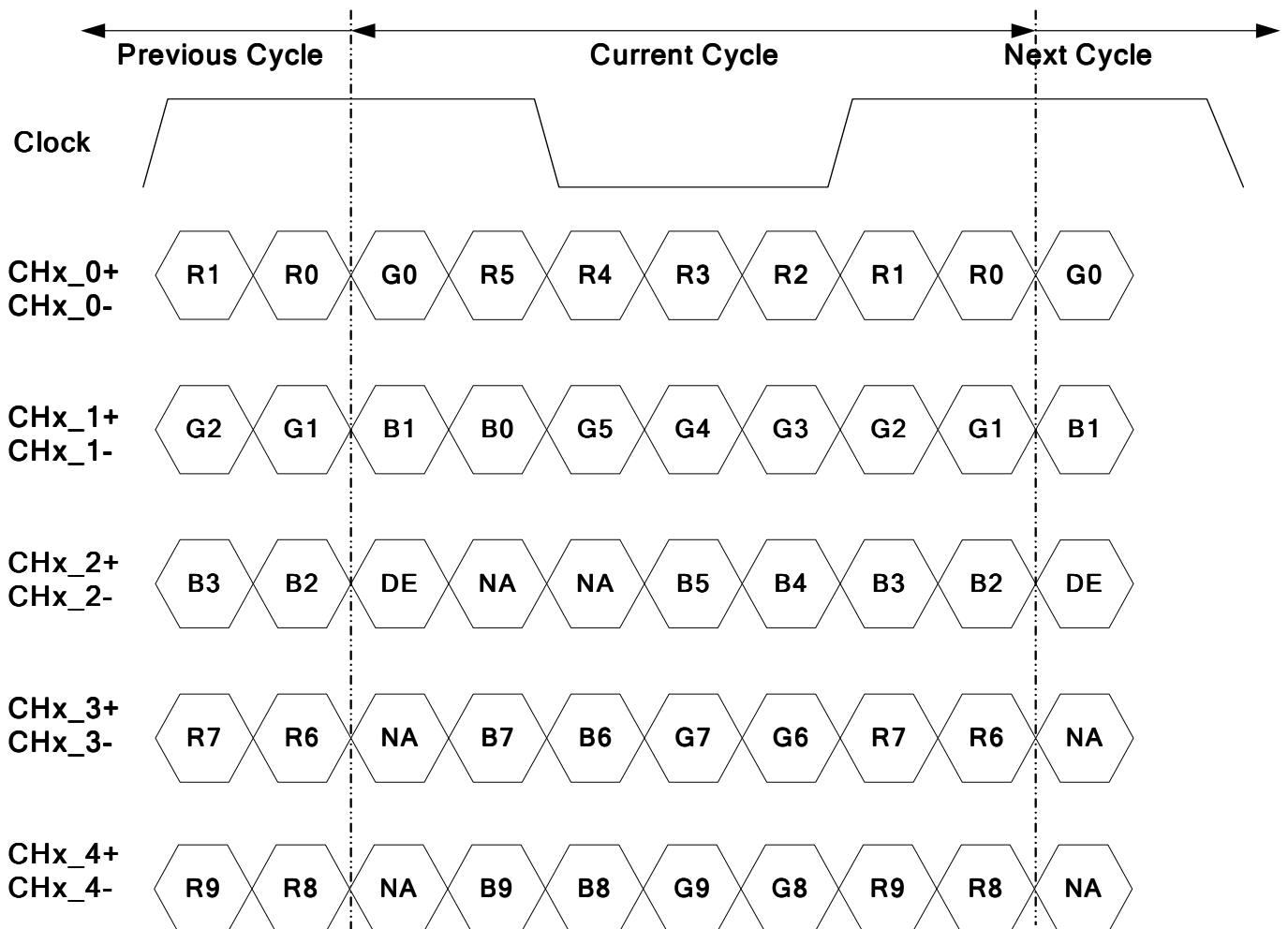
Note * : Open/High(3.3V)



Note ** : Open/Low(GND)

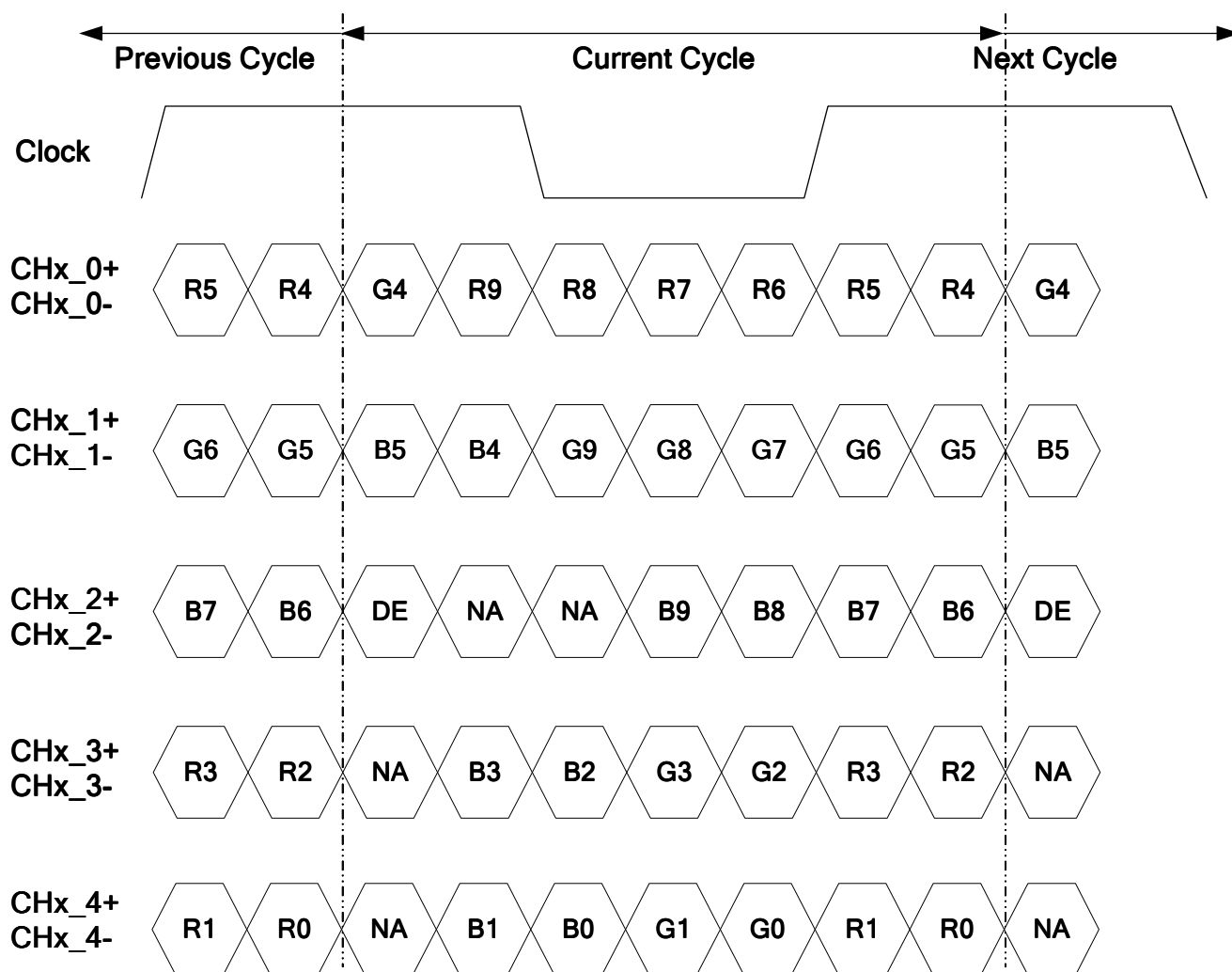


LVDS Option = High/Open → NS



Note: x = 1, 2, 3, 4...

LVDS Option = Low → JEIDA



Note: x = 1, 2, 3, 4...

3.3 Signal Timing Specification

This is the signal timing required at the input of the user connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

Timing Table (DE only Mode)

Vertical Frequency Range (60Hz)

Signal	Item	Symbol	Min.	Typ.	Max	Unit
Vertical Section	Period	Tv	1100	1125	1480	Th
	Active	Tdisp (v)	1080			Th
	Blanking	Tblk (v)	20	45	400	Th
Horizontal Section	Period	Th	1040	1100	1328	Tclk
	Active	Tdisp (h)	960			Tclk
	Blanking	Tblk (h)	80	140	368	Tclk
Clock	Frequency	Fclk=1/Tclk	50	74.25	82	MHz
Vertical Frequency	Frequency	Fv	47	60	63	Hz
Horizontal Frequency	Frequency	Fh	60	67.5	73	KHz

Notes:

(1) **Horizontal Blanking must be even number**

(2) Display position is specific by the rise of DE signal only.

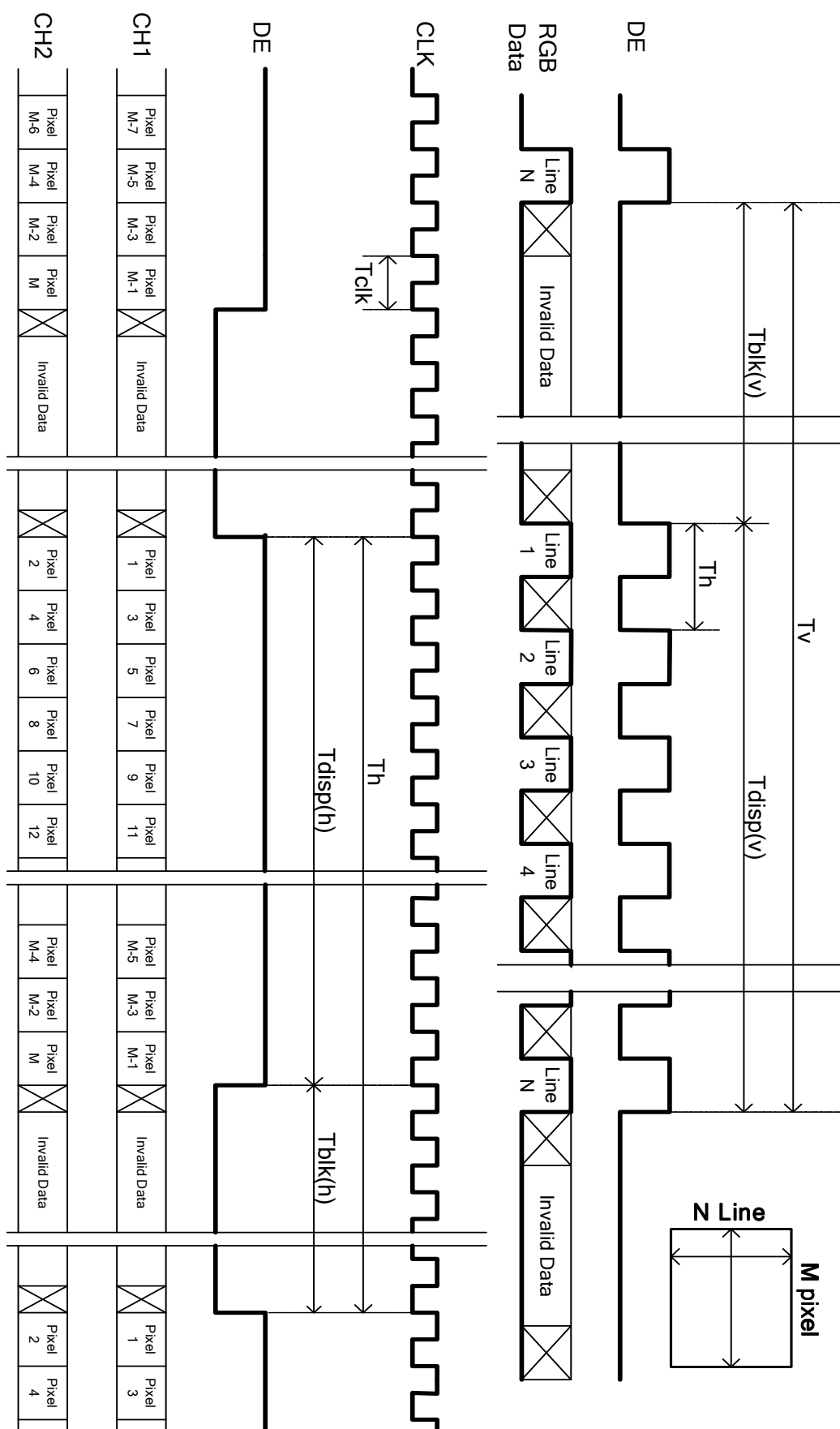
Horizontal display position is specified by the rising edge of 1st DCLK after the rise of 1st DE, is displayed on the left edge of the screen.

(3) Vertical display position is specified by the rise of DE after a “Low” level period equivalent to eight times of horizontal period. The 1st data corresponding to one horizontal line after the rise of 1st DE is displayed at the top line of screen.

(4) If a period of DE “High” is less than 1920 DCLK or less than 1080 lines, the rest of the screen displays black.

(5) The display position does not fit to the screen if a period of DE “High” and the effective data period do not synchronize with each other.

3.4 Signal Timing Waveforms



3.5 Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 10 bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

COLOR DATA REFERENCE

Color		Input Color Data																															
		RED										GREEN										BLUE											
		MSB					LSB					MSB					LSB					MSB						LSB					
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0		
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Green(1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
	Blue(1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
R	RED(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED(001)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

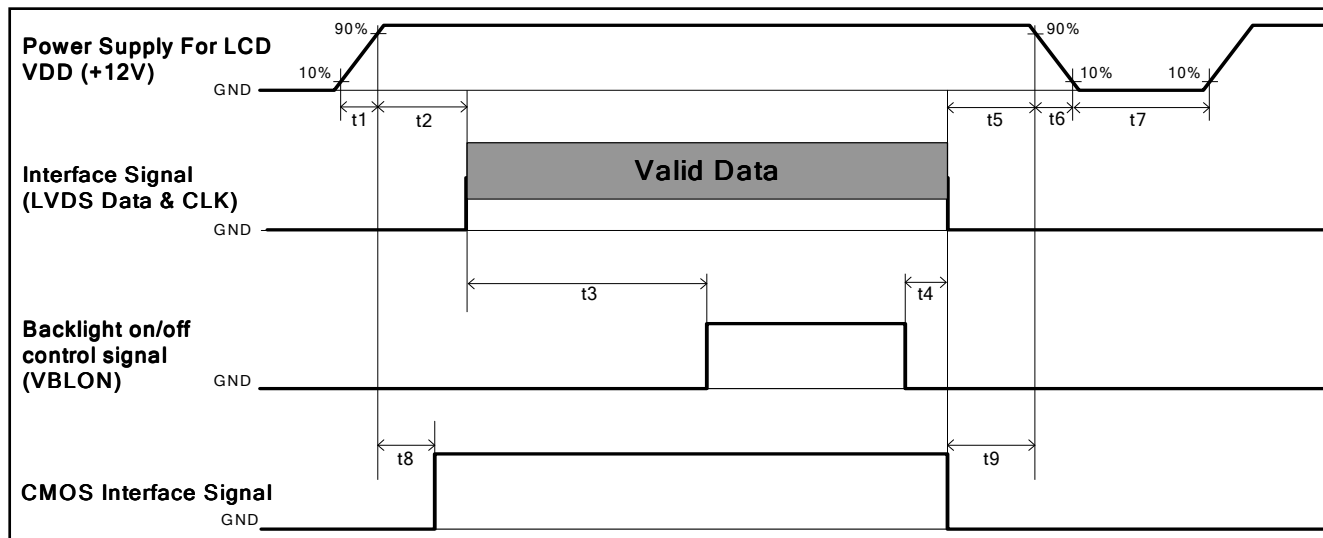
	RED(1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED(1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
G	GREEN(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	GREEN(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0		

	GREEN(1022)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0		
	GREEN(1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
B	BLUE(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	BLUE(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		

	BLUE(1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0		
	BLUE(1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		

3.6 Power Sequence

◆ Power Sequence of LCD



Parameter	Values			Unit
	Min.	Type.	Max.	
t1	0.4	---	30	ms
t2	0.1	---	50	ms
t3	450	---	---	ms
t4	0 ^{*1}	---	---	ms
t5	0	---	---	ms
t6	---	---	--- ^{*2}	ms
t7	500	---	---	ms
t8	10	---	50	ms
t9	0	---	---	ms

Note:

- (1) t4=0 : concern for residual pattern before BLU turn off.
- (2) t6 : voltage of VDD must decay smoothly after power-off. (customer system decide this value)
- (3) When CMOS Interface signal is N.C. (no connection), opened in Transmitted end, t8 timing spec can be negligible.

3.7 Backlight Specification

The backlight unit contains 8pcs LED lightbar.

3.7.1 Electrical specification

	Item	Symbol	Condition	Spec			Unit	Note
				Min	Typ	Max		
1	Input Voltage	V _{DDB}	-	22.8	24	25.2	VDC	-
2	Input Current	I _{DDB}	V _{DDB} =24V	--	8.6	9	ADC	1
3	Input Power	P _{DDB}	V _{DDB} =24V	--	206.4	216.1	W	1
4	Inrush Current	I _{RUSH}	V _{DDB} =24V	-		16	Apeak	2
5	Control signal voltage	V _{Signal}	V _{DDB} =24V	2	-	5.5	VDC	-
				0	-	0.8		3
6	Control signal current	I _{Signal}	V _{DDB} =24V	-	-	1.5	mA	-
7	External PWM Duty ratio (input duty ratio)	D_EPWM	V _{DDB} =24V	0	-	100	%	4,5
8	External PWM Frequency	F_EPWM	V _{DDB} =24V	110	180	240	Hz	4,5
9	DET status signal	DET	V _{DDB} =24V	Open Collector			VDC	6
				0	-	0.8	VDC	6
10	Input Impedance	R _{in}	V _{DDB} =24V	300			Kohm	-

Note 1: Dimming ratio= 100%, (Ta=25±5℃, Turn on for 45minutes)

Note 2: MAX input current at all operating mode, measurement condition Rising time = 20ms (V_{DDB}: 10%~90%)

Note 3: When BLU off (V_{DDB} = 24V, V_{BLON} = 0V), I_{DDB} (max) = 0.1A

Note 4: Less than 5% dimming control is functional well and no backlight shutdown happened

Note 5: D_EPWM and F_EPWM are available only at 2D mode

Note 6: Normal: 0~0.8V ; Abnormal : Open collector

3.7.2 Input Pin Assignment

14pin pin assignment

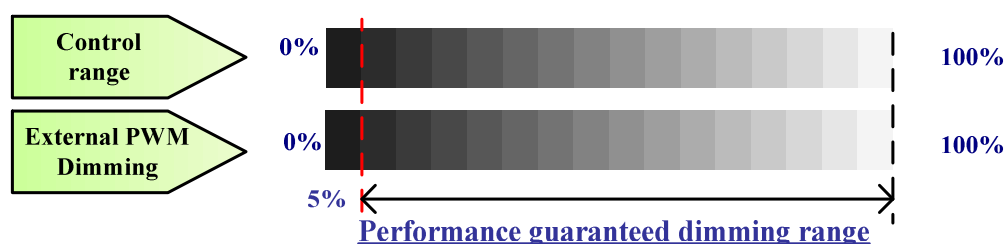
Connector: CI0114M1HR0-NH(CviLux) or equivalent

Pin NO.	Symbol	Pin Configuration (function)
1	VDDDB	Operating Voltage Supply, +24V DC regulated
2	VDDDB	Operating Voltage Supply, +24V DC regulated
3	VDDDB	Operating Voltage Supply, +24V DC regulated
4	VDDDB	Operating Voltage Supply, +24V DC regulated
5	VDDDB	Operating Voltage Supply, +24V DC regulated
6	BLGND	Ground and Current Return
7	BLGND	Ground and Current Return
8	BLGND	Ground and Current Return
9	BLGND	Ground and Current Return
10	BLGND	Ground and Current Return
11	DET	BLU status detection: Normal : 0~0.8V ; Abnormal : Open collector (Recommend Pull high R > 10K, VDD = 3.3V)
12	VBLON	BL On-Off control High/Open (2.0V~5.5V) for BL On, Low (0~0.8V/GND) for BL off
13	NC	NC
14	PDIM (*)	External PWM (5%~100% Duty, open for 100%)

12pin pin assignment

Connector: CI0112M1HR0-NH(CviLux) or equivalent

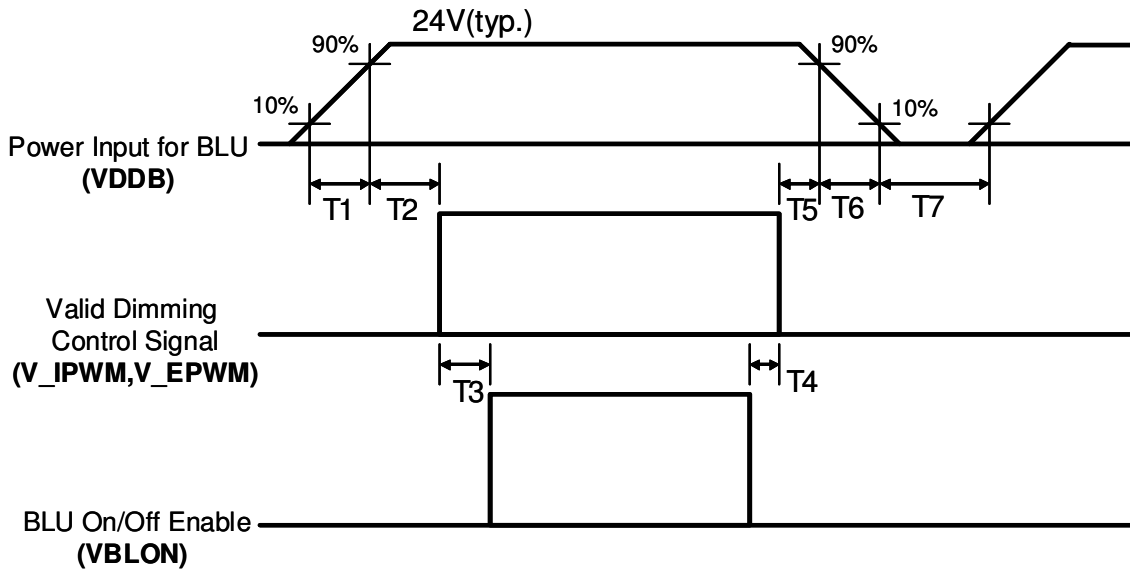
Pin NO.	Symbol	Pin Configuration (function)
1	VDDDB	Operating Voltage Supply, +24V DC regulated
2	VDDDB	Operating Voltage Supply, +24V DC regulated
3	VDDDB	Operating Voltage Supply, +24V DC regulated
4	VDDDB	Operating Voltage Supply, +24V DC regulated
5	VDDDB	Operating Voltage Supply, +24V DC regulated
6	BLGND	Ground and Current Return
7	BLGND	Ground and Current Return
8	BLGND	Ground and Current Return
9	BLGND	Ground and Current Return
10	BLGND	Ground and Current Return
11	NC	NC
12	NC	NC



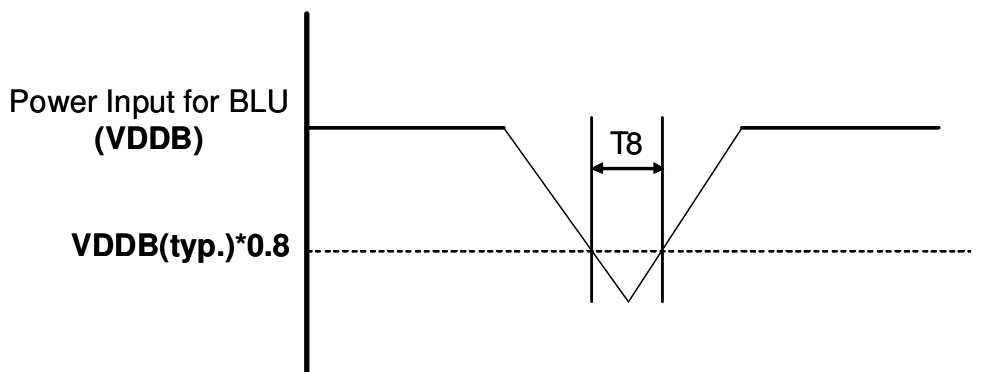
(Note*) If External PWM function is less than 5% dimming ratio. Judge condition as below:

- (1) Backlight module must be lighted ON normally.
- (2) All protection function must work normally.
- (3) Uniformity and flicker could NOT be guaranteed

3.7.3 Power Sequence for Backlight



Dip condition for LED Backlight



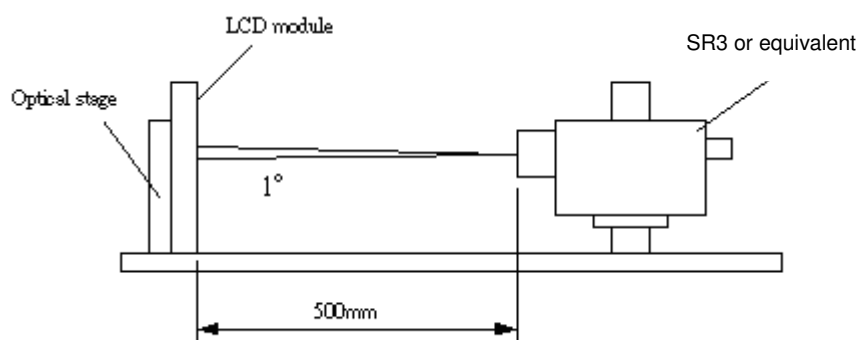
Parameter	Value			Units
	Min	Typ	Max	
T1	20	-	-	ms ^{*1}
T2	500	-	-	ms
T3	250	-	-	ms
T4	0	-	-	ms
T5	1	-	-	ms
T6		-	-	ms
T7	500	-	-	ms
T8	-	-	10	ms

Note: 1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time. Even though T1 is over the specified value, there is no problem if I2t spec of fuse is satisfied.

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 45 minutes in a dark environment at 25°C while panel is placed in the default position. The default position is T-con side as the top side of panel. The value specified is at an approximate distance 50cm from the LCD surface at a viewing angle of φ and θ equal to 0°.

Fig.1 presents additional information concerning the measurement equipment and method.



Parameter		Symbol	Values			Unit	Notes
			Min.	Typ.	Max		
Contrast Ratio		CR	3200	4000	--		1
Surface Luminance (White)		L_{WH}	560	700	--	cd/m ²	2
Luminance Variation		$\delta_{WHITE(9P)}$	--	--	1.33		3
Response Time (G to G)		T_y	--	6.5	--	Ms	4
Color Gamut		NTSC		72		%	
Color Coordinates							
	Red	R_x	Typ.-0.03	0.630	Typ.+0.03		
		R_y		0.330			
	Green	G_x		0.320			
		G_y		0.620			
	Blue	B_x		0.150			
		B_y		0.040			
	White	W_x		0.280			
		W_y		0.290			
Viewing Angle							5
	x axis, right($\varphi=0^\circ$)	θ_r	--	89	--	degree	
	x axis, left($\varphi=180^\circ$)	θ_l	--	89	--	degree	
	y axis, up($\varphi=90^\circ$)	θ_u	--	89	--	degree	
	y axis, down ($\varphi=270^\circ$)	θ_d	--	89	--	degree	

Note:

1. Contrast Ratio (CR) is defined mathematically as:

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance of } L_{on5}}{\text{Surface Luminance of } L_{off5}}$$

2. Surface luminance is luminance value at point 5 across the LCD surface 50cm from the surface with all pixels displaying white. From more information see FIG 2. When lamp current $I_H = 11\text{mA}$. $L_{WH} = L_{on5}$ where L_{on5} is the luminance with all pixels displaying white at center 5 location.

3. The variation in surface luminance, δ_{WHITE} is defined (center of Screen) as:

$$\delta_{WHITE(9P)} = \text{Maximum}(L_{on1}, L_{on2}, \dots, L_{on9}) / \text{Minimum}(L_{on1}, L_{on2}, \dots, L_{on9})$$

4. Response time T_γ is the average time required for display transition by switching the input signal for five luminance ratio (0%, 25%, 50%, 75%, 100% brightness matrix) and is based on $F_v = 60\text{Hz}$ to optimize.

Measured Response Time		Target				
		0%	25%	50%	75%	100%
Start	0%		0% to 25%	0% to 50%	0% to 75%	0% to 100%
	25%	25% to 0%		25% to 50%	25% to 75%	25% to 100%
	50%	50% to 0%	50% to 25%		50% to 75%	50% to 100%
	75%	75% to 0%	75% to 25%	75% to 50%		75% to 100%
	100%	100% to 0%	100% to 25%	100% to 50%	100% to 75%	

T_γ is determined by 10% to 90% brightness difference of rising or falling period. (As illustrated)

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG4.

FIG. 2 Luminance

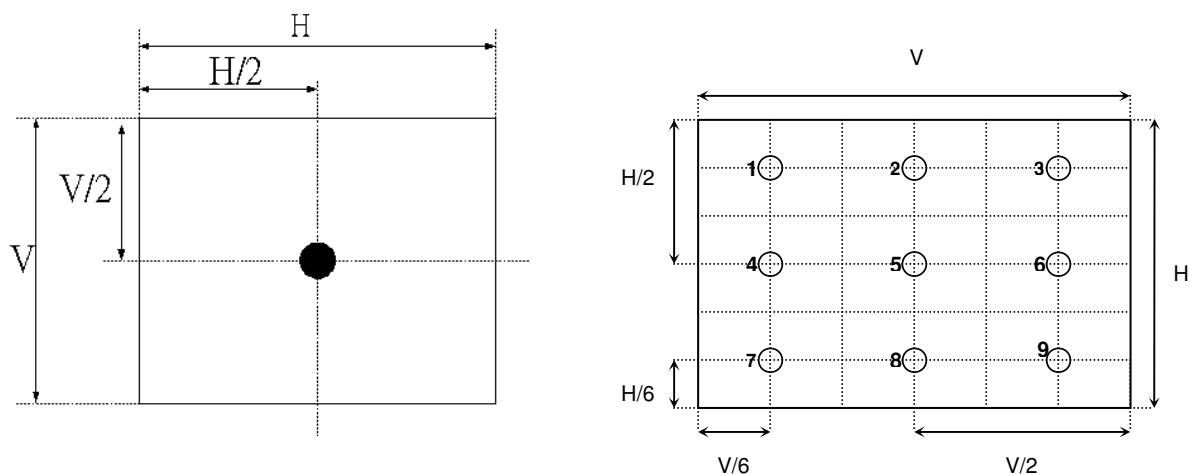


FIG.3 Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for “any level of gray(bright) “ and “any level of gray(dark)”.

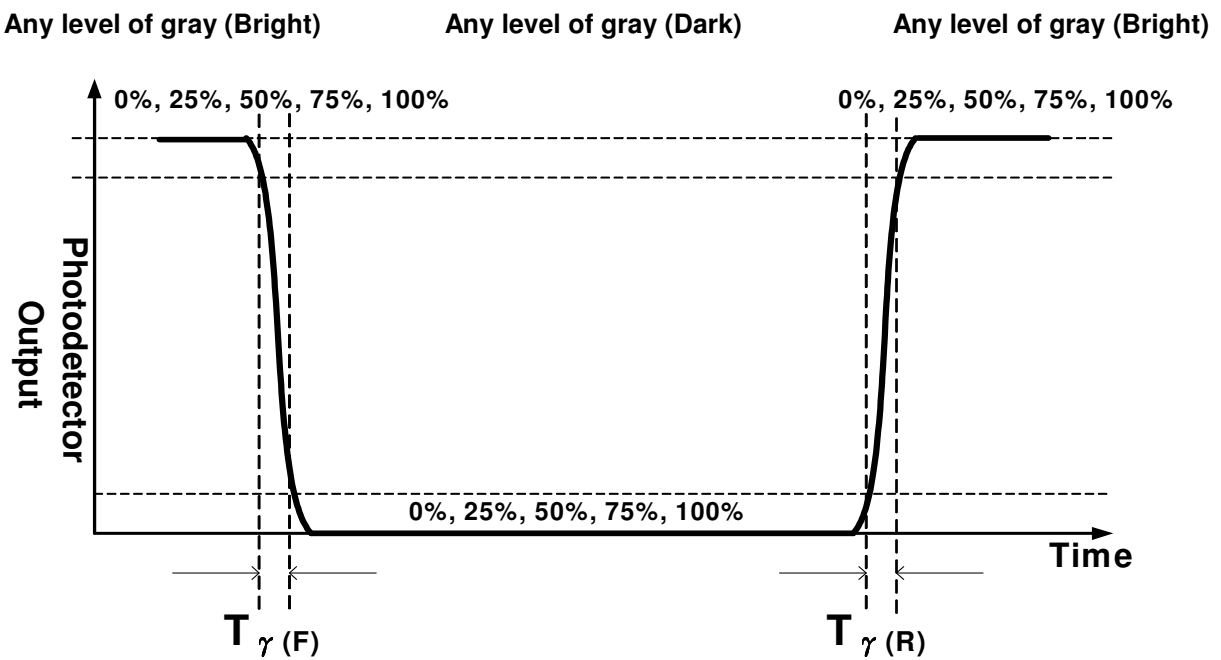
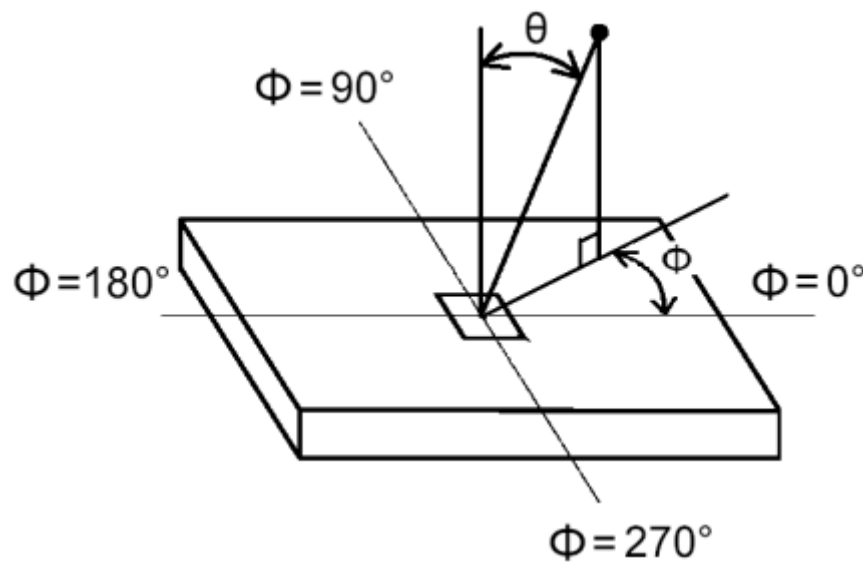


FIG.4 Viewing Angle



5. Mechanical Characteristics

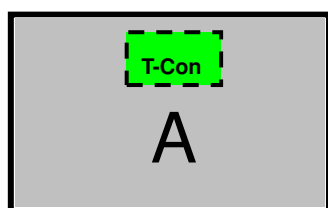
The contents provide general mechanical characteristics for the model P650HVN02.5. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal (typ.)	1508.0mm
	Vertical (typ.)	878.0mm
	Depth (typ.)	12.8mm (thinnest)
Bezel Opening Area	Horizontal (typ.)	1440.6 mm
	Vertical (typ.)	814.6 mm
Active Display Area	Horizontal	1428.48 mm
	Vertical	803.52 mm
Weight	13500g	
Surface Treatment	AG, 3H	

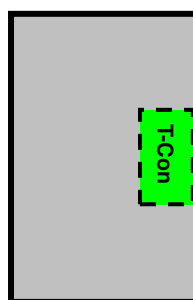
5.1 Placement suggestions:

1. Landscape Mode: The default placement is T-Con Side on the upper side and the image is shown upright via viewing from the front.
2. Portrait Mode: The default placement is that T-Con side has to be placed on the right side via viewing from the front.

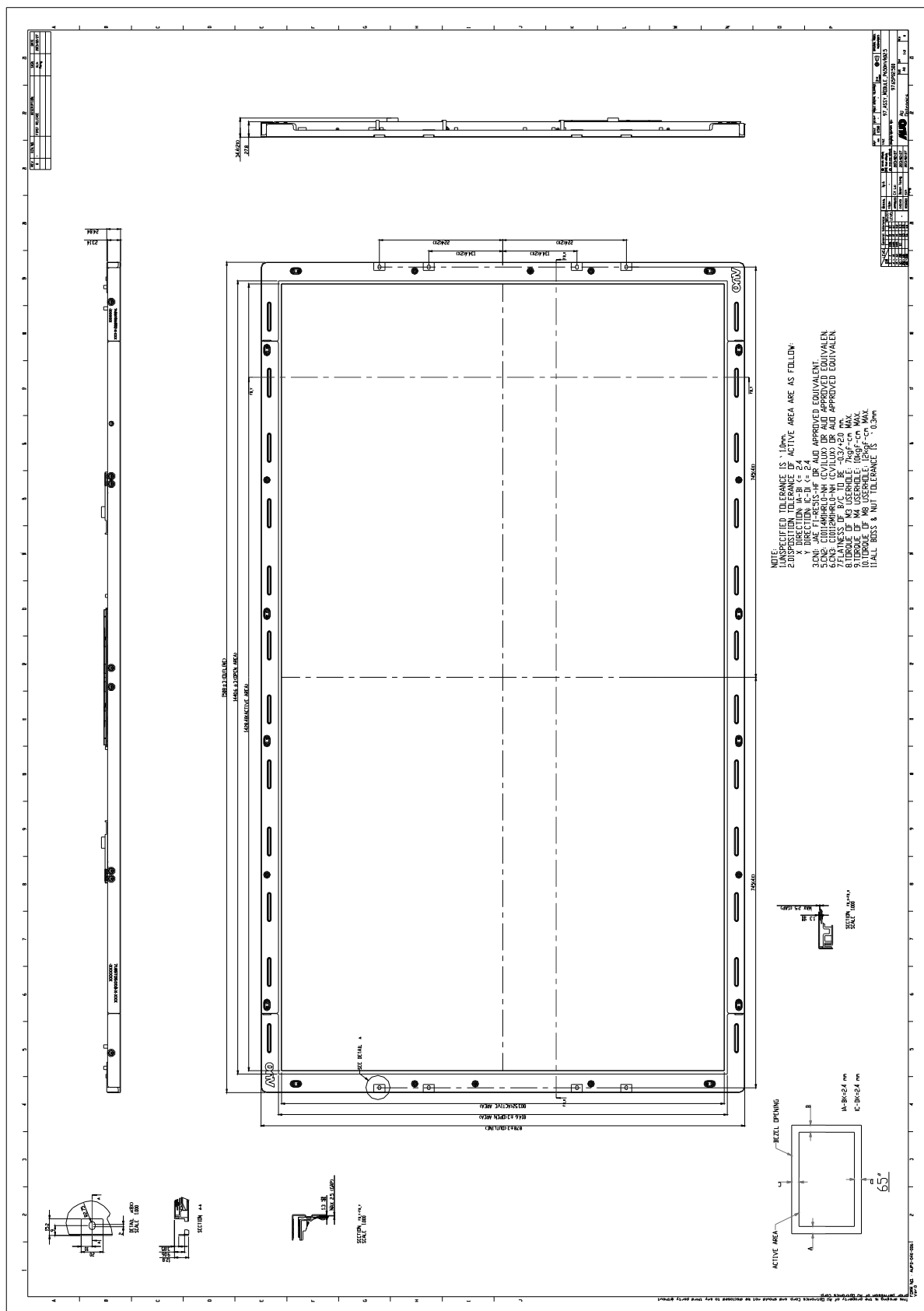
Landscape (Front view)



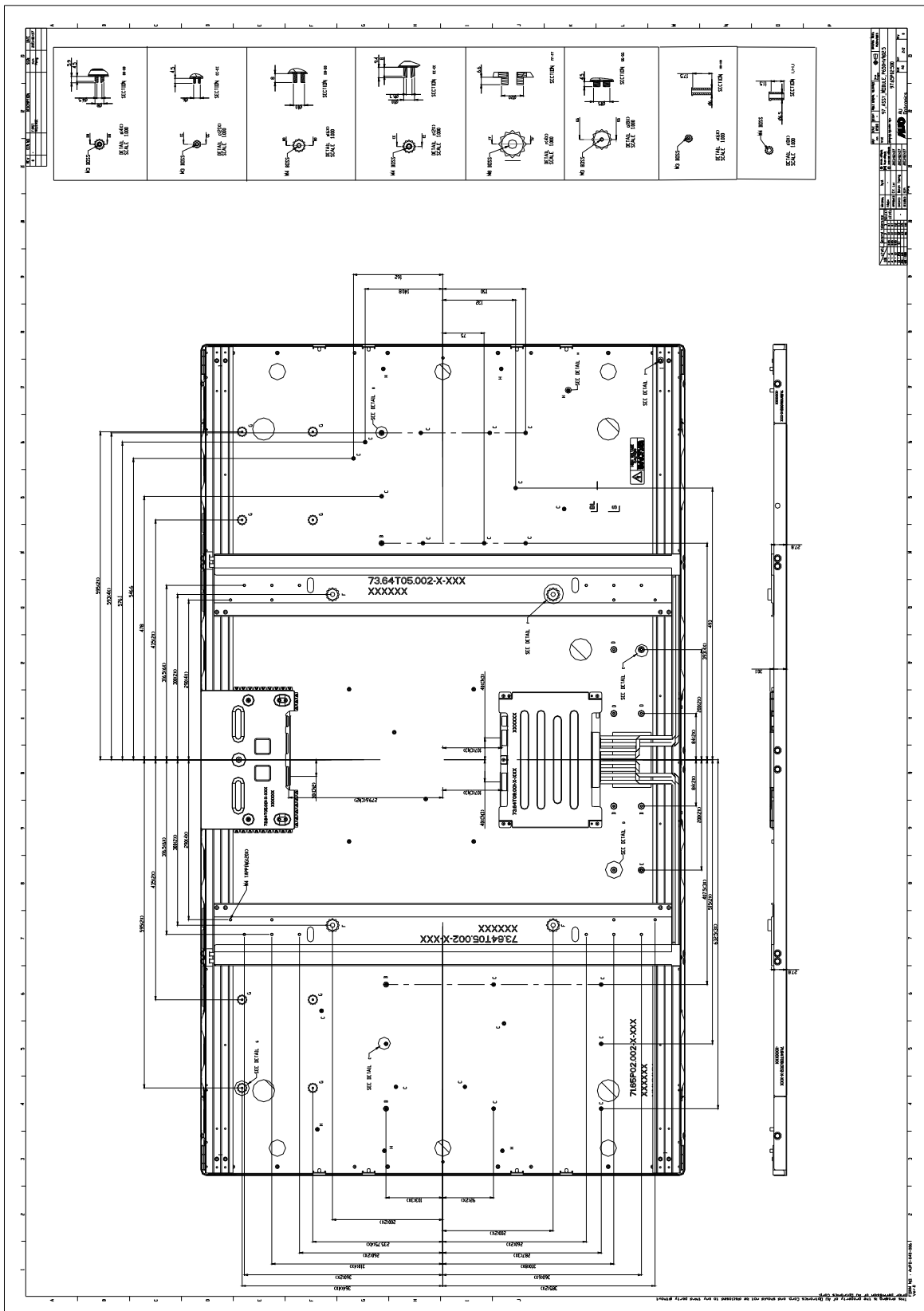
Portrait (Front view)



Front View



Back View



6. Reliability Test Items

	Test Item	Q'ty	Condition
1	High temperature storage test	3	60°C , 500hrs
2	Low temperature storage test	3	-20°C , 500hrs
3	High temperature operation test	3	50°C , 500hrs
4	Low temperature operation test	3	-5°C , 500hrs
5	Vibration test (With carton)	1 (PKG)	Random wave (1.05G RMS, 10-200Hz) 10mins/ Per each X,Y,Z axes
6	Drop test (With carton)	1 (PKG)	Height: 25.4 cm Direction: Only bottom flat twice (ASTMD4169-I)

7. International Standard

7.1 Safety

- (1) UL 60950-1; Standard for Safety of Information Technology Equipment Including electrical Business Equipment.
- (2) IEC 60950-1 : 2001; Standard for Safety of International Electrotechnical Commission
- (3) EN 60950 : 2001+A11; European Committee for Electrotechnical Standardization (CENELEC), EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

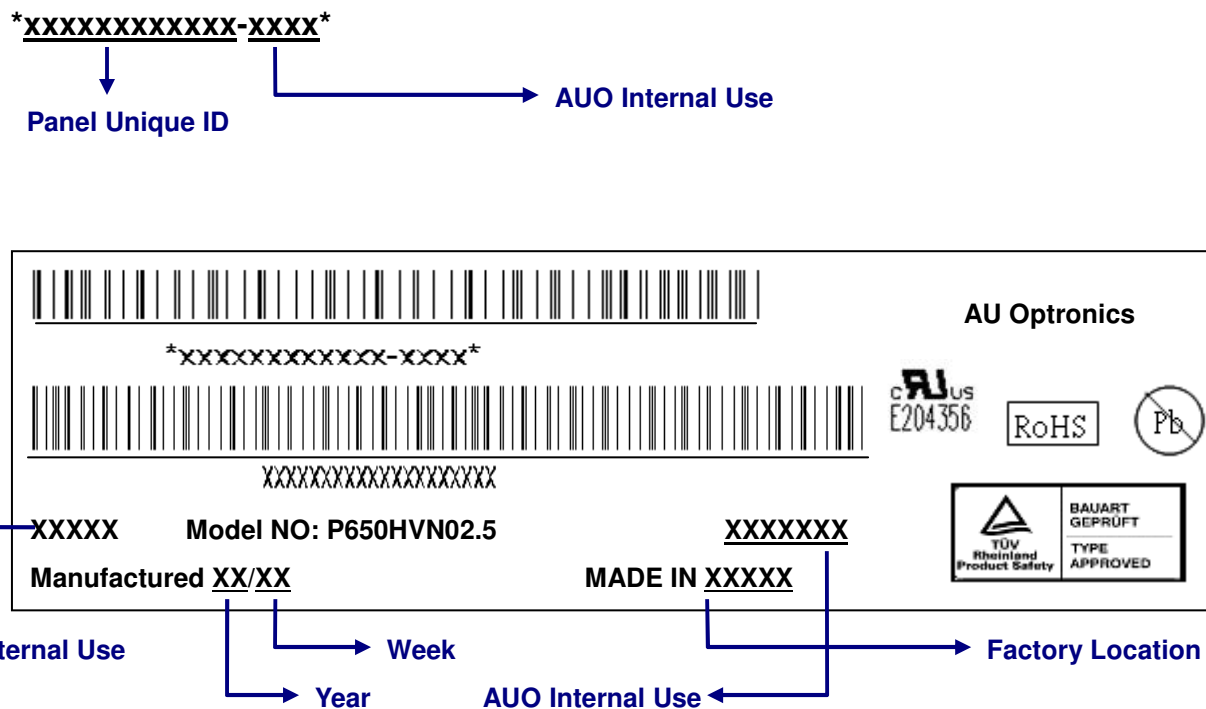
7.2 EMC

- (1) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz. "American National standards Institute(ANSI), 1992
- (2) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special committee on Radio Interference.
- (3) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization. (CENELEC), 1998

8. Packing

8-1 DEFINITION OF LABEL:

A. Panel Label:



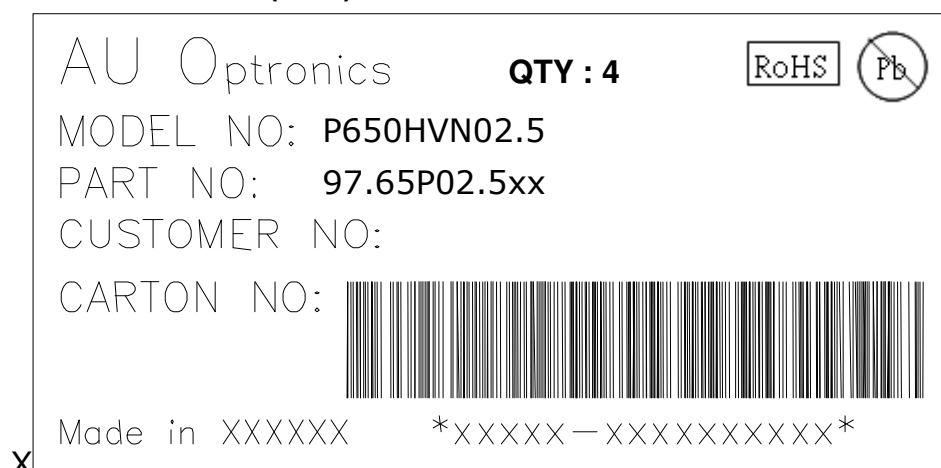
Green mark description

(1) For Pb Free Product, AUO will add  for identification.

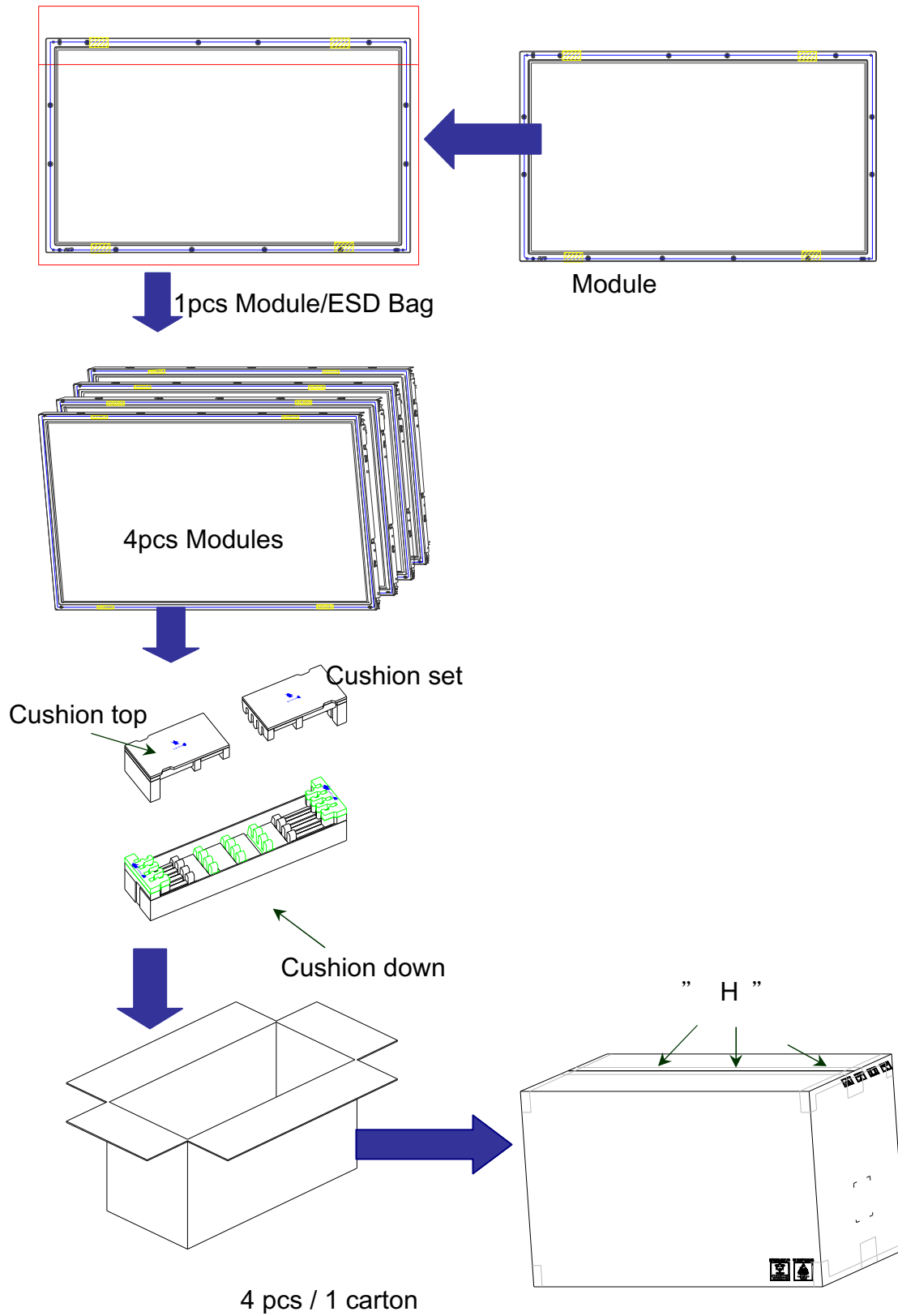
(2) For RoHS compatible products, AUO will add  for identification.

Note: The green Mark will be present only when the green documents have been ready by AUO internal green team. (definition of green design follows the AUO green design checklist.)

B. Carton Label: (TBD)

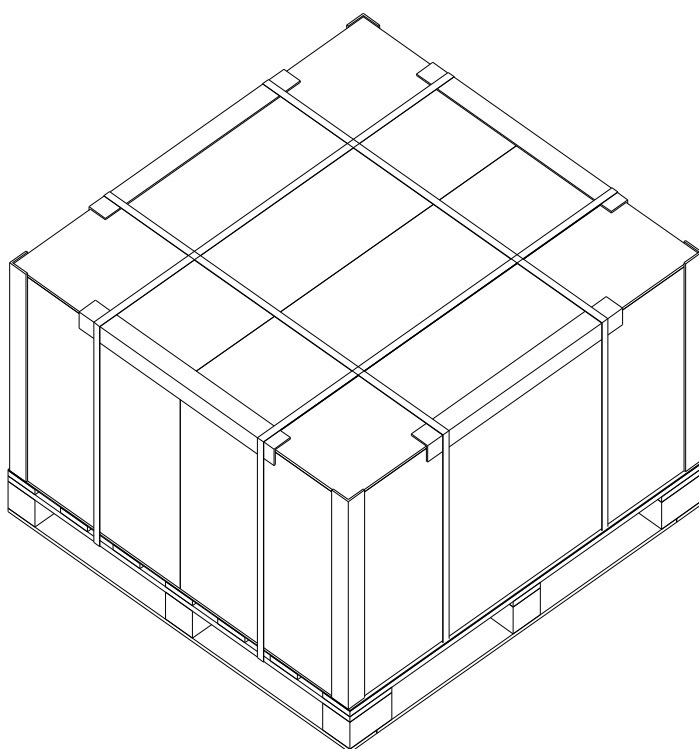


8-2 PACKING METHODS:



8-3 Pallet and Shipment Information

	Item	Specification			Packing Remark
		Qty.	Dimension	Weight (kg)	
1	Packing Box	4pcs/box	1605(L)mm*375(W)mm*1025(H)mm	138	
2	Pallet	1	1660(L)mm*1150(W)mm*138(H)mm	20	
3	Boxes per Pallet	3 boxes/Pallet (By Air) ; 3 Boxes/Pallet (By Sea)			
4	Panels per Pallet	12 pcs/pallet(By Air) ; 12 pcs/Pallet (By Sea)			
5	Pallet after packing	12 (by Air)	1660(L)mm*1150(W)mm*1173(H)mm	434(by Air)	
		24 (by Sea)	1660(L)mm*1150(W)mm*2346(H)mm	868(by Sea)	40ft HQ



9. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

9-1 MOUNTING PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. twisted stress) is not applied to module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter cause circuit broken by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizer with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizer. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2 OPERATING PRECAUTIONS

- (1) The device listed in the product specification sheets was designed and manufactured for public information display application.
- (2) The spike noise causes the mis-operation of circuits. It should be lower than following voltage:
 $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (3) Response time depends on the temperature. (In lower temperature, it becomes longer..)
- (4) Brightness of LED depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (5) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (6) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (7) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall

be done by system manufacturers. Grounding and shielding methods may be important to minimize the interface.

9-3 ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wristband etc. And don't touch interface pin directly.

9-4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

9-5 STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

9-6 HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

9-7 OPERATING CONDITION in PID APPLICATION

- (1) If the continuous static display is required, periodically inserting a motion picture is strongly recommended.
- (2) Recommend to periodically change the background color and background image.
- (3) Recommend not to continuously operate over 18 hours a day.
- (4) Recommend to adopt one of the following actions after long time display.
 - I. Running the screen saver (motion picture or black pattern)
 - II. Power off the system for a while
- (5) Try not to run the LCD in a closed environment. Suitable venting on the system cover would be helpful for cooling.
- (6) It is better to adapt active cooling with fans for long time displaying, especially for high luminance LCD model.